

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problems Mailbox.**

**THIS PAGE BLANK (USPTO)**

**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau

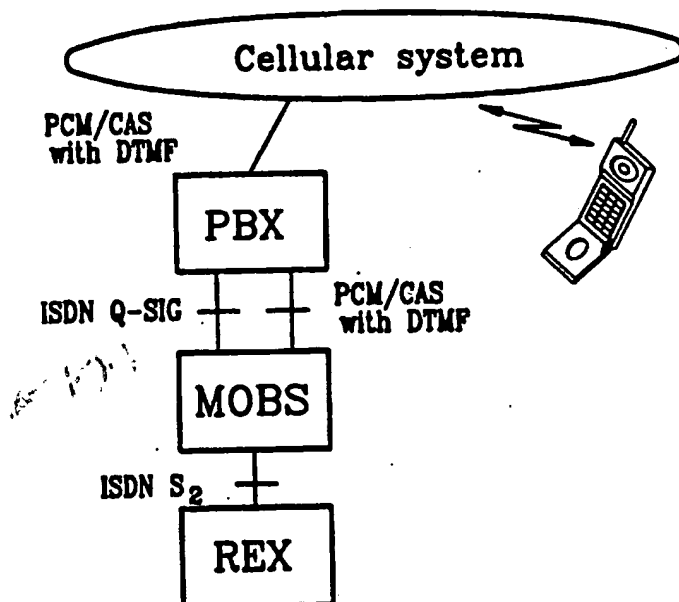
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : <b>H04Q 7/24</b>	<b>A1</b>	(11) International Publication Number: <b>WO 96/21329</b> (43) International Publication Date: <b>11 July 1996 (11.07.96)</b>
(21) International Application Number: <b>PCT/SE95/01555</b> (22) International Filing Date: <b>21 December 1995 (21.12.95)</b>  (30) Priority Data: <b>08/366,471 30 December 1994 (30.12.94) US</b>  (71) Applicant: <b>TELEFONAKTIEBOLAGET LM ERICSSON</b> <b>[SE/SE]; S-126 25 Stockholm (SE).</b>  (72) Inventor: <b>ERIKSSON, Dick; Krogstappan 121, S-136 53</b> <b>Haninge (SE).</b>  (74) Agents: <b>BERGENTALL, Annika et al.; Göteborgs Patentbyrå</b> <b>AB, P.O. Box 5005, S-402 21 Göteborg (SE).</b>		(81) Designated States: <b>AU, FI, NO, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b>  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: **SYSTEM AND METHOD RELATING TO CELLULAR COMMUNICATIONS**

## (57) Abstract

An arrangement providing access between a mobile communications network and a private network with at least one exchange or private branch exchange wherein to the exchange or the private branch exchange mobility serving means are connected over a first interface providing access to/from mobile cellular phones and over a second interface for calls to/from personal number users and wherein a cellular telephone of the mobile cellular network connects to the exchange over an interface.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

Title:

SYSTEM AND METHOD RELATING TO CELLULAR COMMUNICATIONS

5

#### BACKGROUND

The present invention relates to a system and a method for providing cellular mobility within a telecommunications system comprising a single exchange, e.g. a Private Branch Exchange or  
10 a private telecommunications Network Exchange or a private network with a number of exchanges.

The invention further relates to an arrangement for providing a mobile cellular telephone with access to an exchange and particularly to the services provided by the exchange  
15 substantially in the same way as a cordless telephone within radio coverage of a radio exchange adjunct to the exchange. The invention also relates to mobile telecommunications system comprising a cellular communication system and a private network wherein cellular access is provided to the private network and  
20 to the services offered thereby.

In a system known today a cordless user who is within radio coverage of a radio exchange which is adjunct to a private branch exchange has access to the services offered by the private branch  
25 exchange. If however the user is not within radio coverage of a radio switch adjunct to the private branch exchange, a cellular phone has to be used. With the cellular phone it is however not possible to access the services offered by the private branch exchange other than those provided to an ordinary analogue  
30 telephone or a so called POTS phone (plain old telephone service) over the public network.

A number of attempts have been done to provide access to both cellular communication networks and private networks or to interconnect the networks. Through using combined telephones,  
35 i.e. a cellular telephone and a cordless telephone in one which comprises double equipments of transceivers, antennas etc. with which it is possible to change between a cellular network and the

private network. In other systems a user is required to have two different telephones one for the cellular network and one for the private network. None of the systems provide cellular access to the private network or to the services provided by a PBX or a  
5 private network. A combined telephone as referred to above is quite a complicated device and there is also no cellular access provided to the services offered by the private network.

In another system illustrated in EP-A-462 727 a mobile communications network is illustrated comprising a PCN-network  
10 and a private automatic branch exchange (PABX) connected thereto. Calls which involve mobile subscribers associated with the PABX are routed via a base station controller comprising a mobile services switching center functionality of the PCN-network. A private protocol of the PABX is used. This requires that there  
15 are specific protocols in the PABX which means that it is not possible to use the exchange as it is but it has to be modified. Moreover, it is not possible through this arrangement to get access to all services provided by the private branch exchange or the private network and for example the same telephone number  
20 can not be used but an additional numbering plan has to be used for this particular category of users.

Also with this known system it is not possible for a cellular phone to get access to all the services provided by a PBX or a private network and particularly it is not possible to use the  
25 same numbering plan irrespective of whether using a cellular or a cordless phone.

#### SUMMARY

It is an object of the present invention to provide an  
30 arrangement through which cellular phone access to an exchange or to a private network is provided. An exchange may in this application relate e.g. to a Private Telecommunications Network Exchange PTNX. The European Telecommunications Standard Institute defines this as "A PTN nodal entity that provides automatic  
35 switching and call handling functions used for the provision of the telecommunication services. A nodal entity consists of one or more nodes. The nodal entity, performing the functions

outlined above, can be implemented by equipment located on the premises of the private network administrator or by equipment co-located with, or physically part of a public network". Two implementations of PTNX are: PBX, An implementation of a private telecommunications network exchange located on the premises of a private network administrator. Centrex, An implementation of a private telecommunications network exchange not located on the premises of a private network administrator. The invention is in the following mainly described in relation to a PBX, but it likewise applies to a centrex or e.g. any kind of a PTNX, as well as any other relevant exchange. PBX also comprises Private Automatic Branch Exchanges PABX. Thus even if referring to a PBX in this document, the invention as explained above is not limited thereto but also covers other exchanges. More particularly it is an object of the invention to provide an arrangement through which a cellular user gets access to the services provided by an exchange or a private network. It is also an object of the present invention to provide an arrangement and a method respectively through which a cellular user gets a fast access to a private network or to e.g. a private branch exchange and to provide a cellular user with access to most of the extension services provided by the PBX (PTNX) and the private network. Another object with the invention is to provide an arrangement which is easy to use and which has a good security.

25

It is also an object of the invention to provide a communications system comprising a cellular network and a private network wherein cellular telephones easily can access the private network and particularly the services as provided by the private network and wherein a cellular user can access the private network particularly without requiring any networking support from the (private branch) exchange or without imposing requirements on the (private branch) exchange itself.

35 It is also an object with the invention to provide access to a mobile cellular telephone by an internal private branch exchange party or by an external party via the private branch exchange.

These as well as other objects are achieved through connecting a mobility serving means on an interface to an exchange and connecting a cellular system to the mobility serving means directly or over the exchange e.g. a PBX.

5

The exchange and the mobility serving means may particularly be interconnected over two interfaces of which a first is intended for access to/from mobile cellular telephones and a second is intended for calls to/from personal number users. The personal  
10 number is an extension number in e.g. the PBX assigned to a user of a mobile cellular phone. The cellular system is connected to the private branch exchange over an interface with DTMF (Dual Tone Multiple Frequencies) transmission.

15 Alternatively the cellular network is directly connected to the mobility serving means over an interface thus bypassing the exchange.

Applicants copending US patent application "System and method relating to cordless communications" filed on December 30, 1994,  
20 relates to provision of cordless phone access to a PBX (PTNX) or to a private network and to provision of cordless mobility and it is incorporated herein by reference.

The mobility serving means is then arranged between an exchange and a number of radio exchanges interfacing the exchange using  
25 the existing interface from the exchange and the mobility serving means can be said to emulate a radio exchange in interworking with the exchange. Since the interface from the exchange is unchanged, no modification as to the software or the hardware of the exchange is required by the mobility serving means (or  
30 mobility server (MOBS)).

According to the invention the mobile cellular phone in general appears as an extension to the exchange which means that if the user of the mobile cellular phone makes a call within the private numbering plan of the private network, a connection to the  
35 (private branch) exchange will automatically be established.

It is an advantage with the invention that a cellular phone can



access the services provided by a private network in an easy way without imposing any further requirements on private branch exchanges and that a fast access to the private branch exchange can be provided. Another advantage with the invention is that  
5 the same exchange (PBX) extension number can be used irrespective of whether a cordless telephone or a cellular telephone is used. Further advantages will be evident from the more detailed description of the invention.

#### 10 BRIEF DESCRIPTION OF THE DRAWINGS

The invention will in the following be further described in a non-limiting way under reference to the accompanying drawings wherein:

15 Fig 1 illustrates a first embodiment of the invention wherein mobility serving means are connected to a cellular network via a private branch exchange,

Fig 2 illustrates a mobile cellular telephone accessing a  
20 private branch exchange,

Fig 3 illustrates a second embodiment of the invention wherein a cellular network and mobility serving means  
25 a directly interconnected,

Fig 4 illustrates a call to a mobile cellular telephone,

Fig 5 illustrates a signal diagram of a call from a mobile  
switching center with one example of a trunk protocol  
30 and,

Fig 6 illustrates a signal diagram for a call from a mobile  
switching center with a second example of a trunk  
protocol.

## DETAILED DESCRIPTION

In fig 1 a first embodiment of the invention is illustrated comprising a cellular network (for example GSM, ADC, (D-)AMPS etc) to which a private branch exchange PBX is connected. The PBX is connected to a mobile switching center (not shown in the figures) of the cellular network over a dedicated trunk route supporting a protocol with DTMF (Dual Tone Multiple Frequency) transmission of A-numbers (the identity of the calling party). The interface between the PBX and the mobile switching center of the cellular network is in the illustrated embodiment the PCM/CAS interface with DTMF digit transmission. PCM (Pulse Code Modulation) is a common transmission technique worldwide. ITU (formerly CCITT) has issued a number of recommendations for this technique. CAS (Common Channel Signalling) indicates that all bearer channels share one signalling channel for line signalling information. The CCITT recommendations in series G.700-G.795 describe general aspects of digital transmission systems. In particular the following CCITT recommendations apply to PCM and CAS as to be applied in the described application: G.703 "Physical/electrical characteristics of hierarchical digital interfaces", G.704 "Synchronous frame structures used at primary and secondary hierarchical levels", G.711 "Pulse code modulation of voice frequencies", G.731 "Primary PCM multiplex equipment for voice frequencies", G.732 "Characteristics of primary PCM multiplex equipment operating at 2.048 Mbps", G.733 "Characteristics of primary PCM multiplex equipment operating at 1.544 Mbps" and Q.512 "Exchange interfaces for subscriber access". The PBX may e.g. also be connected to wired extensions, operators, the public switched telephone network PSTN and it may also comprise connections e.g. for providing messaging, interceptions services etc.

The private branch exchange can for example be the MD110 by Ericsson and in different embodiments the interconnecting interface can for example be the trunk protocols by Telia P7 which requires additional in-band DTMF after answer, or P8' comprising direct-in-dialling with A-number transfer. Of course these are only examples of protocols relevant to the European GSM

market, corresponding signal protocols exist for other markets and other protocols relating to other systems etc. Thus a number of other protocols can of course also be used. Signalling cases relevant to the two above mentioned trunk protocols will be  
5 illustrated later on in relation to figs 5 and 6.

The PBX is further connected to a mobility server MOBS which in turn can be connected to a number of cordless radio exchanges REX of which only one can be illustrated here for reasons of clarity. The radio exchange REX is connected to the mobility server MOBS  
10 over the ISDN S<sub>2</sub>-interface supporting mobility management. The MOBS is then connected to the PBX on the existing interface between the PBX and the REX which e.g. can be ISDN S<sub>2</sub>, PCM/CAS or an analogue extension. However, for the purpose of the present invention it is irrelevant whether the radio exchanges (REX) are  
15 present or not. In the relation to the ISDN S<sub>2</sub>, the S reference point is adopted in PBX systems as the access interface for extension lines. The S<sub>2</sub> indicates a 2 Mbps primary rate interface (30B+D). Similarly an S<sub>1</sub> interface indicates a 1.5 Mbps primary rate interface (23B+D) used mainly in the USA. The primary rate  
20 interface and its D-channel control signalling allows traffic concentration, i.e. more than 30 or 23 users can be allocated to one interface (S<sub>2</sub> or S<sub>1</sub> respectively). In this particular case it is the PCM/CAS with DTMF signalling. Since the existing interface to the PBX is used, the PBX does not have to be changed which  
25 means that no modification as to the PBX software or to the PBX hardware is required and in interworking with the PBX the MOBS emulates a radio exchange. The PCM/CAS interface (the second interface) is used for calls to/from personal number users. Instead of PCM/CAS e.g. the ISDN S<sub>2</sub> or an analogue extension line  
30 may be used. However, the MOBS is also connected to the PBX over a first interface providing access to/from mobile cellular users. In this case it is the ISDN Q-SIG interface. Q-SIG is an ISDN network protocol set for private networks specified by ETSI. The following ETSI standards apply to basic call and form a basis for  
35 supplementary services: ETS 300 170, "Data link layer protocol at the Q reference point for the signalling channel between two private telecommunication network exchanges", ETS 300 172, "Layer

3 protocol for signalling between exchanges of private telecommunication networks for control of circuit switched calls", ETS 300 329, "Generic functional protocol for the support of supplementary services". The following draft ETSI standards  
5 apply to cordless mobility in private networks: QSIG-CTAU, "Cordless terminal authentication", QSIG-CTLR, "Cordless terminal location registration", QSIG-CTMI, "Incoming CTM call handling", QSIG-CTMO, "Outgoing CTM call handling". The copending US Patent Application "Arrangement and method relating to cordless  
10 communications" which is incorporated herein by a reference among others discusses a number of private networks comprising a number of private branch exchanges connected to mobility servers which are so interconnected as to form an overlay network of mobility servers which provide for transparent access signalling between  
15 them and from cordless telephones to PBXs etc. The present invention of course also relates to any form of the private network wherein the mobility servers are interconnected forming an overlay network even if this is not explicitly illustrated in any figures here; the principle of providing cellular access to  
20 the PBX is the same whether it just relates to one PBX interconnected with one mobility server or whether a number of PBXs are arranged so as to form a network either by themselves assisted by an overlay network formed by the mobility servers or standalone PBXs wherein a number of mobility servers are  
25 interconnected so as to form a network.

Fig 2 relates to a first embodiment of providing a cellular telephone with access to a PBX. The private network comprises a private numbering plan. When the user of the cellular telephone makes a call within the private numbering plan the cellular  
30 network sets up a connection to the trunk route to the PBX and transmits the A-number. Examples on interfaces are discussed in relation to fig 1. The PBX makes for the call coming in on the trunk route a transit call to the MOBS across the ISDN Q-SIG tie-line route and transmits the A-number that was received by it  
35 from the cellular network. The MOBS then analyzes the called number from the PBX and establishes that the call is of such kind that it is to be routed to PBX and that it is to be treated as

a call from the personal number which is associated to the received A-number. Relating to a different embodiments the A-number received from the PBX is converted or not by the MOBS before the PBX is called by the MOBS. Thus it may be a call from the personal number being the same as the regional A-number or it may be a call from a translated A-number.

5 According to an advantageous embodiment a PIN-code is transmitted by the cellular network which is to be verified by the mobility server. This provides a good security and it is e.g. required for the P7 trunk protocol which will be further discussed later on, since the A-number is part of the string of key-pad digits. Additional digits (B-number keyed by the cellular phone user) will be transmitted to the PBX. If no additional digits are received, then the dialtone from the PBX is through connected to the cellular network.

15 According to another embodiment of the present invention which is schematically illustrated in Fig. 3 the cellular network is directly connected to the MOBS instead of indirectly connected to the MOBS via the PBX. Thus, if a cellular user makes a call within the private numbering plan the cellular network sets up a connection to the trunk route to the MOBS and transmits the A-number. The MOBS examines the called number and determines that the call is to be routed to the PBX and that it is to be treated as a call from the personal number identical to the received A-number. As in the foregoing embodiment the received A-number may be converted or not by the mobility server before calling the PBX.

20 In both the embodiments discussed above, when the cellular user makes a call within a private numbering plan he will be automatically connected to the PBX and the cellular phone will appear as an extension to the PBX. Since the cellular phone appears as an extension to the PBX, it will be represented in the PBX with a directory number, class of service, a number of features and a line status etc. The PBX will provide the same functions to the cellular user as to a cordless user which is in radio coverage of a radio exchange adjunct to the PBX in a manner known per se. The cellular user will substantially get access to

all services provided by the PBX of which here a few examples are given such as extension initiated services, e.g. enquiry, transfer, diversion services, busy line services for incoming calls such as call back etc. Operator services such as call  
5 accounting services and other private network services such as least cost routing etc. can also be provided to the cellular user as well as to a roaming cordless user in the same way as if it was question about a cordless user within radio coverage of a radio switch adjunct to the PBX.

- 10 Fig 4 illustrates a call to a mobile cellular telephone, e.g. a GSM portable. A personal number can be called from an internal party of the PBX, e.g. a desk phone, an operator or another personal number, or from an external party through the PBX, e.g. a PSTN phone or a cellular phone. In the Fig the interwork  
15 between the systems is illustrated. The PBX will call the mobility server over a PCM-channel assigned to this personal number and thus the mobility server can identify the called number (step 1). Two different phones can be associated with the personal number: A cellular phone in the GSM network (in this  
20 particular embodiment) and a cordless phone. The mobility server will, based on the personal profile of the personal number and the status of the phones (available or not available), route the call to the cellular phone or to the cordless phone (step 2a and 2b respectively in figure 4). When the call is to be routed  
25 towards the cellular phone the following actions are taken:  
Step 2a, indicated by the arrow 2a: The personal number is converted to the public cellular number by the mobility server and additional access codes may also be added by the mobility server for the required routing through the PBX. The call is then  
30 routed to the PBX over the ISDN Q-SIG interface.  
Step 3 as indicated by arrow 3: The PBX will handle the incoming calls as a normal transit call and there is no additional requirement on the PBX for this traffic case.  
Step 4 as indicated by arrow 4: The mobile switching centre of  
35 the GSM network will handle the incoming call as a normal call to a GSM number. There is no additional requirement on the GSM network for this traffic case.

Under reference to fig 5 a first signalling case will be illustrated for a first trunk protocol by Telia requiring additional in-band DTMF after answer, the P7 protocol. In the signal diagrams of figs 5 and 6, signal arrows represent line signals or ISDN D-channel messages except for the bold arrows which represent voice band DTMF digits or tones.

In relation to Fig 5, the P7 protocol is an example of a simple line signalling protocol used by Telia, a Swedish operator of both wired (PSTN) and wireless networks (cellular). The protocol is applied over PCM/CAS between the mobile switching center and the PBX. In this example two line signals are used for call set-up from the mobile switching center to the PBX: Seizure and Answer. The line signals are using the CAS signal bits a and b. Address information is transmitted by DTMF tones in the voice band between the mobile switching center and the PBX. The address information comprises:

- A-number, i.e. the identity of the calling party. This information is not dialled by the user, but is sent by the network itself after identification of the calling party.
- B-number. This is the address dialled by the calling party. Optionally according to an advantageous embodiment a PIN-code (Personal Identification Number) can be transmitted by the network in order to enhance the fraud protection level.

When the PBX receives the Seizure signal from the cellular network the PBX calls the mobility server over the ISDN Q-SIG interface. The mobility server will then set up a speech connection to a DTMF tone receiver and order the PBX to enter speech state by sending the Connect signal. The PBX will acknowledge the Connect signal by returning Connect Ack and the PBX will through-connect the PBX to the mobility server and also sends the Answer signal over CAS to the mobile switching center. The mobile switching center in turn through-connects the connection and then transmit the address information by DTMF tones to the mobility server.

The mobility server analyzes the received A-number and may optionally validate the PIN-code. The A-number is translated by the mobility server to a personal number, which in turn is

associated with a PCM time slot on the extension access line to the PBX. The mobility server then calls the PBX over the access line and the chosen time slot. The incoming call to the PBX from the mobility server is handled as an ordinary call from an extension by the PBX, i.e. a DTMF tone receiver is connected and a dialtone is sent over the time slot to the mobility server. When the mobility server detects dialtone from the PBX over the access line, then the B-party number is transmitted as DTMF digits to the PBX over the same access line.

- 10 The mobility server then through-connects the call so that the calling party (cellular user) is now transparently connected to the PBX and will receive in-band progress tones such as ring tone or busy tone as any extension of the PBX would. Post-dialling procedures are now possible by end-to-end DTMF if supported by the GSM portable, e.g. a request for intrusion or call-waiting if the called party is busy.

- 20 A second signalling case is illustrated in Fig 6 and in this case, the P8' protocol, the network signalling protocol provides both the A-number and the B-number as part of the call set up sequence. There is no need for inband DTMF transmission of the A-number after answer.

The invention is of course not limited to the shown embodiments but can be varied in a number of ways within the scope of the claims.



## WHAT IS CLAIMED IS:

1. A telecommunications system comprising a cellular mobile  
5 communications network and a private network comprising at least  
one exchange or private branch exchange in which access is  
provided between the cellular mobile communications network and  
the private network,  
wherein the cellular mobile communications network is connected  
10 indirectly or directly to mobility serving means over at least  
one interface providing access to/from mobile cellular telephones  
and,  
wherein the mobility serving means is connected to a private  
branch exchange over a second interface for calls to/from  
15 personal number users.
2. A telecommunications system as in claim 1 wherein the cellular  
network is connected indirectly to the mobility serving means,  
and the at least one interface comprises a first interface  
20 interconnecting the private branch exchange with the mobility  
serving means which first interface provides access to/from  
mobile cellular telephones and wherein a second interface  
connects the cellular network with the private branch exchange.
- 25 3. A telecommunications system as in claim 2,  
wherein the private branch exchange(s) is(are) connected to  
mobile switching center(s) of the cellular mobile communications  
network.
- 30 4. A mobile communication system as in claim 3,  
wherein the private branch exchange is connected to the mobile  
switching center(s) over a dedicated trunk route supporting DTMF  
signalling.
- 35 5. A system as in claim 4,  
wherein the dedicated trunk route provides DTMF transmission of  
an A-party number.

6. A system as in anyone of claims 2-5,  
wherein the first interface is the ISDN Q-SIG interface.
7. A system as in anyone of claims 2-6,  
5 wherein the second interface is the PCM/CAS interface or the ISDN S<sub>2</sub> or an analogue extension line.
8. A system as in anyone of the preceding claims,  
wherein the mobility serving means, further are connected to a  
10 number of radio exchanges via the ISDN S<sub>2</sub>-interface in order to also provide cordless mobility.
9. A telecommunications system as in claim 1,  
wherein the cellular network is connected directly to the  
15 mobility serving means via an interface supporting DTMF signalling with transmission of an A-number.
10. A mobile communication system comprising a mobile cellular communication network and a private network comprising a number  
20 of private branch exchanges each via an interface connecting to mobility serving means,  
wherein the cellular communications network directly interfaces the mobility serving means in order to provide cellular telephone access to the private network so that when a call is made within  
25 the private numbering plan by a mobile cellular user, an automatic connection is established with the private branch exchange.
11. An arrangement for providing access between a mobile cellular  
30 telephone in a mobile communications network and a private network with at least one exchange or private branch exchange,  
wherein to the exchange or private branch exchange mobility serving means are connected (mobility server) over a first interface providing access to/from mobile cellular phones and  
35 over a second interface for calls to/from personal number users, and  
wherein a mobile cellular telephone connects to the (private

branch) exchange over an interface.

12. An arrangement as in claim 11,  
wherein the interface connecting the private branch exchange with  
5 the cellular mobile telecommunications network comprises a  
dedicated trunk route supporting a protocol with DTMF signalling.

13. An arrangement as in claim 12,  
wherein the interface interconnecting the cellular  
10 telecommunications system with the private branch exchange is the  
PCM/CAS interface.

14. An arrangement as in claim 13,  
wherein the A-number is transmitted from the cellular system to  
15 the private branch exchange.

15. An arrangement as in anyone of claims 11-14,  
wherein the first and the second interfaces are the ISDN Q-SIG  
and the PCM/CAS or ISDN S<sub>2</sub> or an analogue extension line.  
20

16. An arrangement as in claim 15,  
wherein a number of radio exchanges interface with the mobility  
server e.g. over the ISDN S<sub>2</sub>-interface.

25 17. An arrangement as in claims 11,  
wherein a connection is automatically established with the  
private branch exchange when a call is made by a mobile cellular  
user within the private numbering plan.

30 18. An arrangement as in claim 17,  
wherein the A-number is transmitted to the private branch  
exchange by the cellular mobile network and wherein the private  
branch exchange comprises means for making a transit call to the  
mobility server and transmitting the A-number,  
35 wherein the mobility server further comprises analyzing means for  
analyzing the code number from the private branch exchange and  
means for determining whether the call is to be routed to the

private branch exchange, in which case the call is treated as a call from the personal number which is identical to the received A-number.

- 5 19. An arrangement as in claim 18,  
wherein the mobility server comprises means for converting the received A-number to a converted A-number which is used when calling the private branch exchange.
- 10 20. An arrangement as in anyone of claims 17-19,  
wherein the mobility server comprises verification means for examining or verifying an identification code e.g. a PIN-code transmitted by the cellular network.
- 15 21. A method for providing a cellular telephone of a cellular mobile communications network with access to a private network when a call is made within a private numbering plan of the private network comprising at least one private branch exchange, through automatically connecting the cellular phone to the
- 20 private branch exchange comprising the steps of:  
setting up a connection within the cellular mobile communication network to a trunk route to the private branch exchange,  
transmitting the A-number,  
making a transit call from the private branch exchange to
- 25 mobility serving means connected to the private branch exchange over a first interface with the A-number,  
analyzing the called number in the mobility server and  
examining if the call is to be routed to the private branch exchange and then, routing the call to the private branch
- 30 exchange over a second interface and  
treating it as a call from the personal number identical to the received A-number.
22. A method as in claim 21,
- 35 wherein the mobility serving means (the mobility server) uses the transmitted A-number when calling the private branch exchange.

23. A method as in claim 21,  
wherein the A-number is converted in the mobility server before  
the mobility server calls the PBX.

5 24. A method for connecting a user of a private branch exchange  
to a mobile cellular telephone,  
wherein the mobile cellular telephone is associated with a  
personal number comprising the steps of:  
from the private branch exchange calling a mobility serving means  
10 connected thereto over a second interface, e.g. PCM/CAS, ISDN S,  
or analogue extension line assigned to the personal number in  
order to identify the called number,  
in the mobility serving means converting the personal number to  
the public cellular number,  
15 routing the call to the private branch exchange over a first  
interface,  
in the private branch exchange handling the call as an ordinary  
transit call,  
from the private branch exchange calling a mobile switching  
20 center of the cellular network which handles the call as an  
ordinary call to a mobile cellular number.

25. A method as in claim 24,  
wherein the user of the private branch exchange is an internal  
25 party of the private branch exchange such as e.g. a desk phone,  
an operator or another personal number.

26. A method as in claim 24,  
wherein the user of the private branch exchange is an external  
30 party calling through the private branch exchange such as e.g.  
a PSTN telephone or a mobile cellular telephone.

1:4

FIG. 1

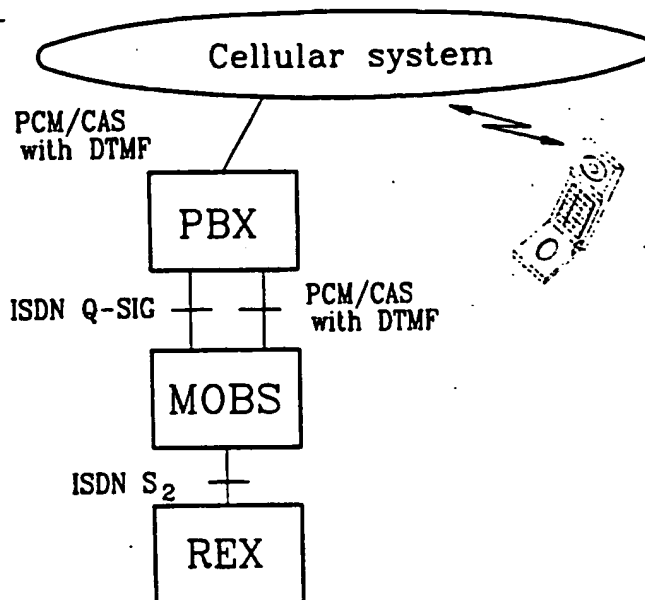


FIG. 2

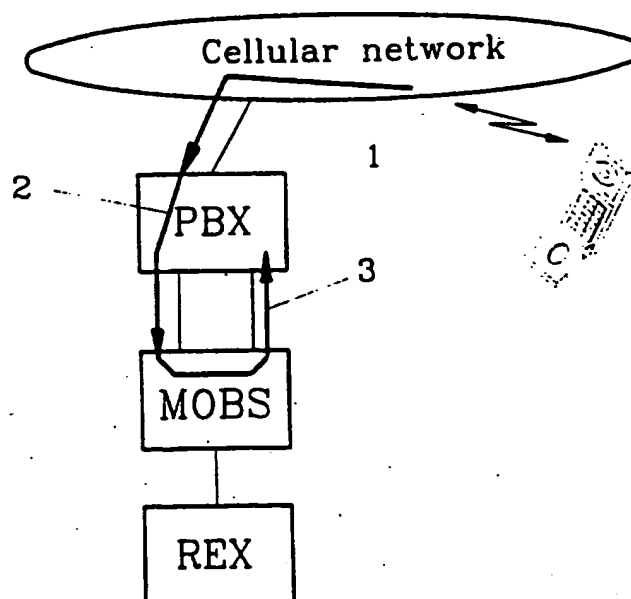


FIG.3

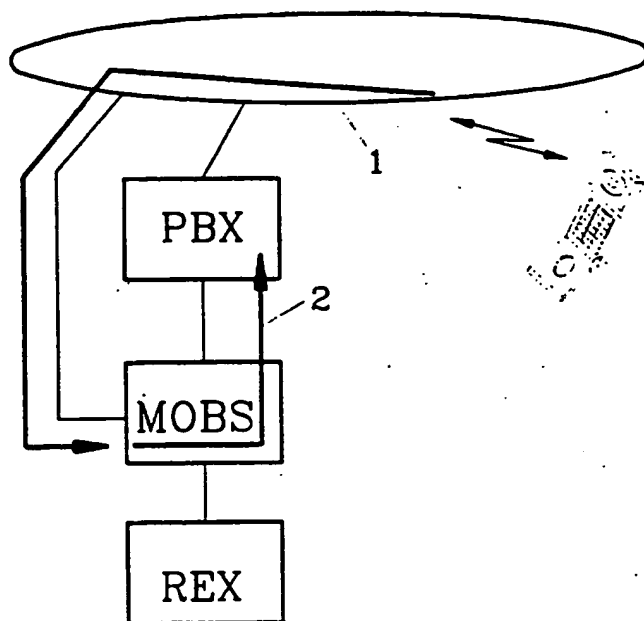
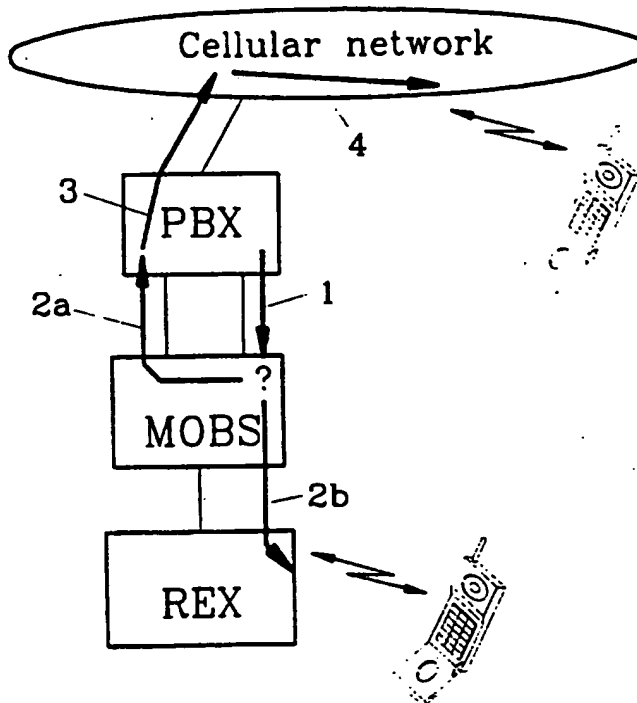
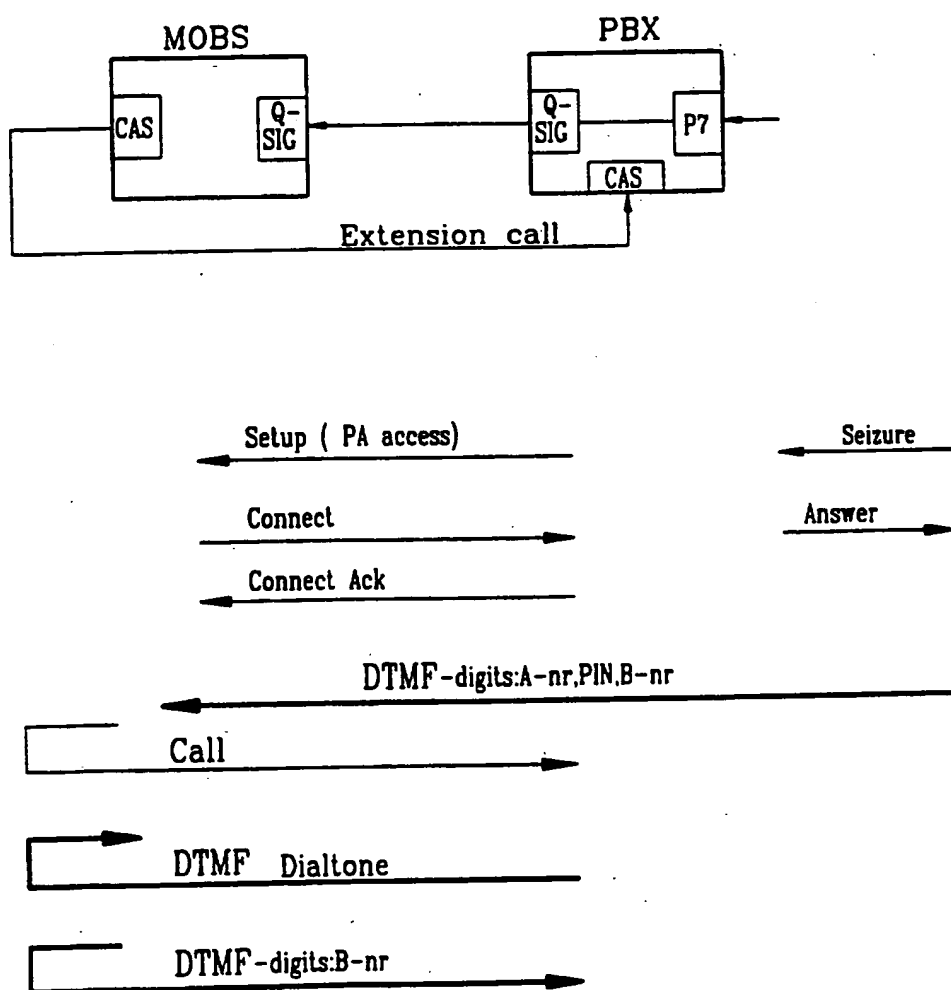


FIG.4



3:4

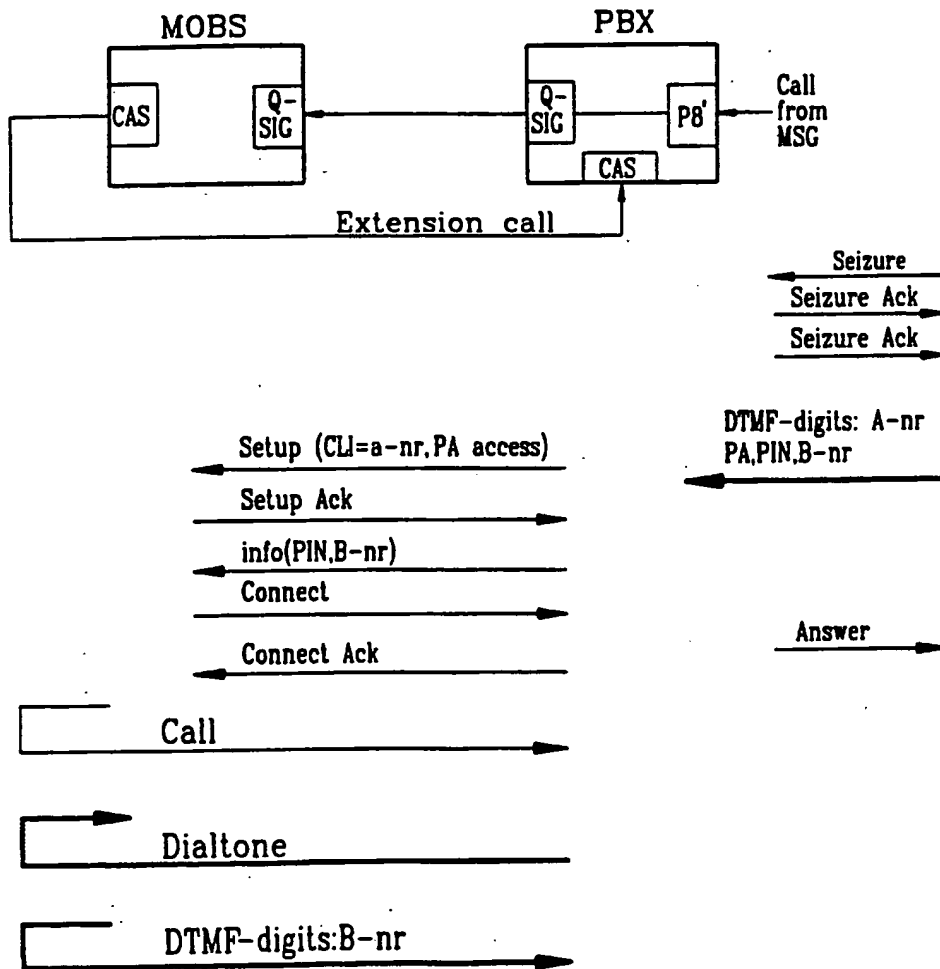
FIG. 5





4:4

FIG. 6



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/SE 95/01555

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04Q7/24

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,94 26073 (ERICSSON TELEFON AB L M) 10 November 1994	1,9,10
Y	see page 2, line 16 - page 3, line 7	2,3,11, 21
	see page 3, line 23 - line 28	
	see page 4, line 26 - page 6, line 8	
	see page 6, line 8 - line 21	
	see page 8, line 3 - page 9, line 7	
	---	
Y	WO,A,94 05129 (ERICSSON TELEFON AB L M) 3 March 1994	2,3,11, 21
	see page 8, line 1 - line 10	
	see page 10, line 9 - line 13	
	---	
	-/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

\*A\* document member of the same patent family

Date of the actual completion of the international search

11 April 1996

Date of mailing of the international search report

23.05.96

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,  
Fax (+ 31-70) 340-3016

Authorized officer

Gerling, J.C.J.

# INTERNATIONAL SEARCH REPORT

Inter- national Application No

PCT/SE 95/01555

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>WO,A,94 05126 (POSTI JA TELELAITOS ;MAKKONEN MATTI (FI); POEKKAЕ TAPANI (FI); LEH) 3 March 1994 see page 1, line 19 - line 28 see page 2, line 11 - line 25 see page 3, line 20 - page 4, line 1 ---</p>	24-26
A	<p>WO,A,93 11625 (MOTOROLA INC) 10 June 1993 -----</p>	

## INTERNATIONAL SEARCH REPORT

Inter- national Application No  
PCT/SE 95/01555

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9426073	10-11-94	AU-B-	6694694	21-11-94
		CA-A-	2137136	30-10-94
		CN-A-	1108463	13-09-95
		EP-A-	0653140	17-05-95
		FI-A-	946141	28-12-94
		JP-T-	7508634	21-09-95
		NO-A-	944961	21-12-94
-----				
WO-A-9405129	03-03-94	SE-C-	500197	02-05-94
		AU-B-	667230	14-03-96
		AU-B-	4594693	15-03-94
		BR-A-	9305610	04-04-95
		CN-A-	1083990	16-03-94
		EP-A-	0609412	10-08-94
		FI-A-	941774	15-04-94
		JP-T-	7500471	12-01-95
		SE-A-	9202373	19-02-94
-----				
WO-A-9405126	03-03-94	FI-A-	933744	27-02-94
		AU-B-	4960693	15-03-94
		CA-A-	2143319	03-03-94
		EP-A-	0671110	13-09-95
		HU-A-	71653	29-01-96
		JP-T-	8502391	12-03-96
		NO-A-	950715	31-03-95
		PL-A-	307680	12-06-95
		AU-B-	7462594	21-03-95
		FI-A-	942842	16-12-95
		WO-A-	9506381	02-03-95
-----				
WO-A-9311625	10-06-93	AU-B-	659239	11-05-95
		AU-B-	2862992	28-06-93
		BR-A-	9205588	27-09-94
		EP-A-	0570545	24-11-93
		JP-T-	6505612	23-06-94
		NZ-A-	245079	27-02-96
-----				